TAXONOMY AND CONSERVATION OF MEDICINAL PLANTS IN CANAL-IRRIGATED AREAS OF PUNJAB, PAKISTAN

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ABSTRACT

The taxonomic position of 131 medicinal plants from the canal-irrigated areas of Punjab belonging to 112 families and 52 genera is presented. Their life form, parts used and pharmaceutical uses are also described. The most important family was Fabaceae containing 21 medicinal species, followed by Apiaceae, Asteraceae, Lamiaceae, Solanaceae (6 species each), Cucurbitaceae, Malvaceae, and Poaceae (5 species each). Life form analysis of these medicinal plants indicates that all life forms are represented with the majority herbaceous. To conserve this natural wealth, an integrated strategy for both saving species and meeting the increased demand for medicinal plants is suggested. The main points of this strategy should include formulation of a comprehensive policy, increased ethnobotanical surveys and sustainable production of medicinal plants through their cultivation.

Key Words: Canal irrigation, medicinal plants, taxonomy, pharmaceutical uses, conservation, Pakistan

RESUMEN

Se presenta la posición taxonómica de 131 plantas medicinales de las áreas irrigadas del canal del Punjab pertenecientes a 52 familias y 112 géneros. Se describen también las formas vitales, partes usadas y usos farmacéuticos. La familia más importante es Fabaceae con 21 especies medicinales, seguida por Apiaceae, Asteraceae, Lamiaceae, Solanaceae (6 especies cada una), Cucurbitaceae, Malvaceae, y Poaceae (5 especies cada una). El análisis de las formas vitales de estas plantas medicinales indica que están representadas todas con predominio de las herbáceas. Para conservar esta riqueza natural, se sugiere una estrategia integrada tanto para salvar las especies como para abordar la creciente demanda de plantas medicinales. Los puntos principales de esta estrategia serían incluir la formulaci—n de una pol'tica integral, incremento de estudios etnobotánicos y la producción sostenible de plantas medicinales mediante su cultivo.

INTRODUCTION

Pakistan has the distinction of having the largest contiguous gravity-flow irrigation system in the world. The Pakistani irrigation system has been greatly expanded since independence in 1947. This irrigation system serves as a lifeline for sustaining agriculture and is the main source of livelihood for the 70% population. Punjab has a well-developed irrigation system with a net work of

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[1] Disclaimer: The views expressed in this articles are those of authors and do not necessarily represent those of their respective departments. The publication of this article does not constitute a recommendation or endorsement of the use of these plants as herbal medicine. The authors or their departments make no warranty, expressed or implied, and assume no legal liability for the use of these plants for medical purposes.

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canals, water channels and distributaries. The canal-irrigated areas account for 90% of agricultural production and employ 54% of the labor force (Khan 2002).

Pakistan is rich in plant resources with more than 6,000 plant species of higher plants (Nasir & Rafiq 1995). The irrigated areas of Punjab are rich in phyto-diversity, containing a wealth of cultivated crops, natural vegetation and wild flora (Ahmad 2003). This includes plants used in traditional herbal medicine. Research on medicinal plants in the irrigated areas of Punjab has been generally ignored in respect to developing a scientific understanding of the dynamics of natural resources, organization and evolution of human systems. This apparent lack of attention to irrigated, cropped areas has resulted in a paucity of scientific data about the natural vegetation of these areas. There are a few studies listing the medicinal plants from various regions of Pakistan (Ahmad & Waseem 2004; Athar & Ahamd 2004; Athar & Siddiqi 2004; Gill 2003). However, the irrigated areas of Punjab have not been explored adequately in floristic surveys, and a comprehensive documentation of the medicinal flora of the region also is lacking. Pressure on the wild plants of these areas is expected to increase with increasing agricultural, urban and industrial activities. The natural vegetation, including medicinal plants, of these areas is severely degrading, and there is an immediate need to protect and preserve these plant resources. This study is aimed at compiling a list of medicinal plants in canal-irrigated areas of Punjab with information about their taxonomic position, life form and pharmaceutical utilization of different plant parts. The study also explores the reasons for the decline of medicinal plants in the irrigated areas and suggests measures for their conservation.

MATERIALS AND METHODS

A literature search was conducted to determine the medicinal plants used for various disorders or diseases in canal-irrigated areas of Punjab, Pakistan (Baquar 1989, 1995; Joshi, 2003; Maheshwari 2003; Nasir & Ali 1972; Nasir & Rafiq 1995; Palaniswamy 2003; Rahim 1996; Rizvi 1998; Shaheen et al. 2003; Tivari & Tandon 2004; William & Ahmad 1999). Their taxonomic position, life form and pharmaceutical utilization of different plant parts were also determined. The plants included herbs, shrubs and trees. The genera were arranged alphabetically within each family. The English and local names that are commonly associated with these plants are provided. The nomenclature and classification followed Nasir and Ali (1972), and author citations followed Brummitt and Powell (1992).

RESULTS AND DISCUSSION

This study represents the first comprehensive survey of medicinal plants in the irrigated areas of Punjab, Pakistan with suggested strategies to conserve this natural wealth by both saving the medicinal plants and meeting their increased

TABLE 1. Some important medicinal plants in irrigated areas of Punjab.

Species	Local name	English name	Life form	Part used	Pharmaceutical uses
		MONOCOTYLEDONS			
Agavaceae					
Agave americana L.	Banskeora	Agave	Herb	Leaves, roots	Astringent
Alliaceae					
Allium cepa L.	Piaz	Onion	Herb	Bulbs, leaves, seeds	Anti-ulcerative
Allium sativum L.	Lehson	Garlic	Herb	Bulbs, leaves	Cholesterol, blood pressure
Asparagaceae					
Asparagus adscendens Roxb.	Musli sufaid	Garden asparagus	Shrub	Seeds, roots	Antidiarrhoeal, demulcent, galactogogue
Asphodelaceae					
Aloe vera (L.) Burm. f.	Gheekawar	Aloe	Herb	Whole plant	Cosmetic agent, febrifuge, anthelmintic
Cyperaceae					
Cyperus rotundus L.	Dela	Sweet cyperus	Herb	Roots	Diaphoretic, lithontriptic, liver tonic
Poaceae					
Bambusa bambos (L.) Voss	Tabasheer	Bamboo	Tree	Leaves, roots	Tonic, astringent antidiarrhoeal
Bambusa bambos (L.)Voss	Bans	Bamboo	Tree	Leaves, stem	Styptic, tonic, desiccative
Cymbopogon citratus (DC.) Stapf.	Izkhir	Russ grass	Herb	Stem	Antiseptic, stomachic, styptic
Cymbopogon jwarancusa (Jones) Schult.	Khowi ghas	Russ grass	Herb	Flowers	Detoxifier, astringent and tonic
Zea mays L.	Makai	Maize, corn	Herb	Flowers	Astringent, chloretic, diuretic and remedy for urinary infection
		DICOTYLEDONS			
Amaranthaceae					
Achyranthes aspera L.	Pathkanda	Prickly chaff	Herb	Whole plant	Astringent, diuretic

Table 1. continued

Species	Local name	English name	Life form	Part used	Pharmaceutical uses
Apiaceae					
Apium graveolens L.	Soya	Dill	Herb	Roots, seeds, stem	Rheumatism, arthritis, indigestion, flatulence, urinary tract inflammation and infection, neurasthenia, sleeplessness, anxiety and nervous breakdown
Centella asiatica (L.) Urb.	Brahmi booti	Pennywort	Herb	Leaves	Anti-inflammatory, diuretic
Coriandrum sativum L.	Dhania	Coriander	Herb	Leaves, stem	Antispasmodic, appetizer, aromatic
Daucus carota L.	Gajar	Carrot	Herb	Roots, stem	Aphrodiasic, exhilarant, diuretic
Foeniculum vulgare Mill.	Saunf	Fennel	Herb	Leaves, stem	Digestive, lactagogue, masticatory, flavoring agent
Trachyspermum ammi (L.) Sprague ex Turrill	Ajowan	Omum	Herb	Leaves, stem	Stimulant, antispasmodic
Apocynaceae					
Alstonia scholaris (L.) R. Br.	Shaitan-ka-Jhad	Devil's tree	Tree	Bark	Fever treatment
Nerium oleander L.	Kaner	Oleander	Shrub	Leaves, roots	Abortifacient, attenuant, anti-inflammatory
Tabernaemontana divaricata (L.) R. Br. ex Roem. & Schult.	Chandani	Nero's crown	Herb	Flowers, roots	Anthelmintic
Asclepiadaceae					
Calotropis gigantea (L.) W.T. Aiton	Madar	Gigantic swallowort	Shrub	Whole plant	Expectorant, alterative
Calotropis procera (Aiton) W.T. Aiton	Ak	Swallowort	Shrub	Whole plant	Diaphoretic, emetic, diuretic

TABLE 1. continued

Species	Local name	English name	Life form	Part used	Pharmaceutical uses
Asteraceae					
Ageratum conyzoides L.	Ajganda	Goat weed	Herb	Flowers, leaves	Emetic, digestive tonic
Calendula officinalis L.	Zergul	Calendula	Herb	Flowers	Diaphoretic, antiemetic
Carthamus tinctorius L.	Kusumba	Safflower	Herb	Flowers, stem	Emmenagogue, laxative, sedative, stimulant
Eclipta prostrata (L.) L.	Bhangra	Eclipta	Herb	Whole plant	Deobstruent, antiasthmatic
Matricaria recutita L.	Babuna	Chamimila	Herb	Flowers	Carminative, stimulant
Xanthium strumarium L.	Banukra	Cocklebur	Herb	Whole plant	Diaphoretic, emollient
Boraginaceae					
Cordia dichotoma G. Forst.	Lasora	Sebestan plum	Tree	Fruits	Demulcent, laxative
Heliotropium europaeum L.	Oont chara		Herb	Whole plant	Skin disorders
Brassicaceae					
Brassica juncea (L.) Czern.	Rai	Brown mustard	Herb	Seeds	Emetic
Lepidium sativum L.	Chandrasur	Common cress	Herb	Leaves, roots	Stimulant, anti-inflammatory
Sisymbrium irio L.	Khub kalan	Hedge mustard	Herb	Leaves, seeds	Skin disorders
Cactaceae					
Opuntia dillenii (Ker Gawl.) Haw.	Chappal	Prickly pear	Shrub	Whole plant	Demulcent, expectorant
Cannaceae					
Canna indica L.	Aqeeq	Indian Shot	Herb	Roots, seeds	Diaphoretic, diuretic, demulcent
Cannabinaceae					
Cannabis sativa L.	Bhang	Indian hemp	Herb	Flowers, leaves	Sedative, narcotic
Capparidaceae					
Capparis spinosa L.	Karir	Capper plant	Shrub	Roots	Anti-inflammatory, anti-flatulent, resolvent
Cleome gynandra L.	Hulhul	Caravalla seed	Shrub	Leaves, seeds	Rubefacient, anthelmintic
Cleome viscosa L.	Hurhur	Wild mustard	Herb	Leaves, seeds	Rubefacient, anthelmintic

Table 1. continued

Species	Local name	English name	Life form	Part used	Pharmaceutical uses
Chenopodiaceae					
Chenopodium album L.	Bathu	White goose foot	Herb	Seeds	Anthelmintic
Dysphania ambrosioides (L.) Mosyakin & Clements	Sak	Mexican tea	Herb	Seeds	Vermifuge
Combretaceae					
Terminalia arjuna (Roxb. ex DC.) Wight & Arn.	Arjan	Arjun tree	Tree	Bark	Stomachic, anti-ischemic and cardioprotective
Terminalia bellirica (Gaertn.) Roxb.	Bahira	Beleric myrobalan	Tree	Fruits	Bronchodilatory, antispasmodic, antiphlegmatic, expectorant and sedative activities
Terminalia chebula Retz.	Harir	Bidda nut	Tree	Fruits	Stomachic, alterative
Convolvulaceae					
Cuscuta reflexa Roxb.	Akas bel	Dodder	Herb	Seeds	Carminative, alterative, anodyne
Crassulaceae					
Kalanchoe pinnata (Lam.) Pers.	Zakhame hayat	Life plant	Herb	Leaves	Antiseptic, styptic
Cucurbitaceae					
Citrullus colocynthis (L.) Schrad.	Tumma	Colocynth	Herb	Fruit, roots	Anthelmintic, antipyretic
Citrullus lanatus (Thunb.) Matsum. & Nakai var. *lanatus*	Tarbooz	Water melon	Herb	Fruits, seeds	Laxative, brain tonic
Lagenaria siceraria (Molina) Standl.	Kaddo	Gourd	Herb	Seeds	Brain tonic
Luffa acutangula (L.) Roxb.	Ghia tori		Herb	Fruits, seeds	Bitter tonic, diuretic
Momordica charantia L.	Karela	Bitter gourd	Herb	Fruits, leaves, seeds	Anthelmintic, purgative
Euphorbiaceae					
Chamaesyce hirta (L.) Millsp.	Dhodak	Snake weed	Herb	Leaves, stem	Purgative, rubefacient
Euphorbia neriifolia L.	Thanda thor	Milk bush	Tree	Latex, roots	Purgative, expectorant, antispasmodic

TABLE 1. continued

Species	Local name	English name	Life form	Part used	Pharmaceutical uses
Phyllanthus niruri L.	Bhoin avail	Myroblan	Herb	Leaves, roots	Diuretic, astringent, bitter tonic
Ricinus communis L.	Arind	Castor oil	Shrub	Leaves, seeds	Emetic, anti-inflammatory
Fabaceae (Caesalpinioideae)					
Bauhinia purpurea L.	Kaliar	Purple Bauhinia	Tree	Bark, flowers, flower buds	Purgative, indigestion, body pain
Bauhinia semla Wunderlin	Kandla	Bauhinia	Tree	Bark, leaves, flowers	Astringent, diarrhea, dysentry
Bauhinia variegata L.	Kachnar	Mountain ebony	Tree	Bark, flower buds, roots	Blood purifier, anthelmintic
Cassia fistula L.	Amaltas	Golden shower	Tree	Fruits, leaves, roots	Emollient, febrifuge
Chamaecrista absus (L.) H.S. Irwin & Barneby	Chaksu	Chaksu	Herb	Leaves, seeds	Astringent, detersive, heamotonic, opthalmic
Senna alata (L.) Roxb.	Dadmurdan	Ringworm shrub	Tree	Leaves	Purgative, expectorant, aperient
Senna alexandrina Mill.	Sana	Senna	Herb	Leaves	Purgative
Tamarindus indica L.	Imli	Tamarind	Tree	Bark, leaves, fruits	Cooling, antibilious
Fabaceaae (Mimosoideae)					
Acacia modesta Wall.	Phulai		Tree	Gum	Emollient
Acacia nilotica (L.) Delile	Kikar	Acacia	Tree	Flowers, leaves	Emollient, astringent, styptic
Albizia lebbeck (L.) Benth.	Siris	Lebbek tree	Tree	Bark, leaves	Astringent, oral therapy
Mimosa pudica L.	Chhui-mooi	Touch me not	Herb	Leaves	Emetic, renal diseases
Fabaceae (Papilionoideae)					
Alhagi maurorum Medik.	Jawansa	Camel's thorn	Shrub	Whole plant	Laxative, demulcent, expectorant
Clitoria ternatea L.	Gokarni	Butterfly pea	Herb	Roots, seeds	Cathartic, demulcent
Cullen plicata (Delile) C.H. Stirt.	Bakuchi	Babchi	Herb	Seeds	Anthelmintic, diaphoretic
Erythrina stricta Roxb. var. *suberosa* (Roxb.) Niyomdham	Pangra	Coral tree	Tree	Bark	Cathartic, anthelmintic

TABLE 1. continued

Species	Local name	English name	Life form	Part used	Pharmaceutical uses
Indigofera tinctoria L.	Neel	Indigo plant	Herb	Whole plant	Deobstruent, alterative
Sesbania grandiflora (L.) Pers.	Bansa	Sesbania	Tree	Roots, flowers	Rheumatism, fever, diabetes
Sesbania sesban (L.) Merr.	Janter	Sesbania	Shrub	Leaves, flowers	Suppuration, anti-fertility
Trigonella foenum-graecum L.	Methi	Fenugreek	Herb	Leaves, seeds	Aperient, nutritive, expectorant
Vigna unguiculata (L.) Walp. subsp. *cylindrica* (L.) Verdc.	Kulatha	Horse gram	Herb	Seeds	Astringent, diuretic, lithontriptic
Lamiaceae					
Lallemantia royleana (Benth.) Benth.	Tukham-i-balanga		Herb	Seeds	Cooling, mucilaginous, anti-inflammatory
Mentha arvensis L.	Podina	Mint	Herb	Whole plant	Carminative
Mentha ×piperita L.	Podina	Peppermint	Herb	Leaves	Aromatic oil, digestive disorders
Ocimum basilicum L.	Niazbo	Sweet basil	Herb	Flowers, seeds	Carminative, expectorant
Ocimum tenuiflorum L.	Tulsi	Holy basil	Herb	Flowers, leaves, roots	Stimulant, antiseptic
Salvia plebeia R. Br.	Salbia	Sage	Herb	Seeds	Treating boils and wounds
Linaceae					
Linum usitatissimum L.	Alsi	Linseed	Herb	Seeds	Diuretic, emollient
Lythraceae					
Lawsonia inermis L.	Mehndi	Henna plant	Shrub	Whole plant	Hair tonic, hepatic disorders
Malvaceae					
Abutilon bidentatum A. Rich.	Pattaka	Country mallow	Herb	Leaves, seeds	Demulcent, diuretic
Abutilon indicum (L.) Sweet	Peeli booti	Country mallow	Shrub	Leaves, roots, seeds	Demulcent, laxative, sedative
Gossypium herbaceum L.	Kapas	Cotton	Herb	Seeds	Detersive, emollient, expectorant
Malva sylvestris L.	Khubazi	Common mallow	Herb	Fruits, leaves	Throat infections
Sida cordifolia L.	Simak	Country mallow	Shrub	Leaves, roots	Astringent, diaphoretic

Table 1. continued

Species	Local name	English name	Life form	Part used	Pharmaceutical uses
Meliaceae					
Azadirachta indica A. Juss.	Neem	Margosa tree	Tree	Whole plant	Adrenalgic stimulant, dyspepsia, skin diseases, insecticidal
Melia azedarach L.	Drek	Persian lilac	Tree	Flowers, leaves	Anthelmintic, antispasmodic
Toona ciliata M. Roem.	Tun	Indian mahogany	Tree	Bark	Astringent
Moraceae					
Ficus benghalensis L.	Bar	Banyan	Tree	Leaves, latex	Astringent, viscous, resolvent, desiccative
Ficus religiosa L.	Pipal	Pipal tree	Tree	Bark, fruits	Astringent, antiasthmatic
Ficus virens Aiton	Pilkhan		Tree	Fruits, stem	Astringent, stomachic
Moringaceae					
Moringa oleifera Lam.	Soanjan	Horse radish tree	Tree	Flowers, leaves	Anthelmintic, antipyretic
Myrtaceae					
Barringtonia acutangula (L.) Gaertn.	Jugar	Indian Oak	Tree	Bark, roots, seeds	Astringent, emetic
Myrtus communis L.	Wilayti mehndi	Myrtle	Shrub	Fruits, leaves	Antiseptic, disinfectant
Psidium guajava L.	Amrood	Guava	Tree	Fruits, seeds	Astringent, febrifuge, antiseptic, laxative
Nyctaginaceae					
Boerhavia diffusa L.	Itsit	Hog weed	Herb	Leaves, roots	Diuretic, diaphoretic, anthelmintic
Mirabilis jalapa L.	Gul-i-abbas	Four o'clock plant	Shrub	Leaves, roots	Demulcent, antispasmodic
Nymphaeaceae					
Nelumbo nucifera Gaertn.	Kanwal	Water lily	Herb	Fruits, leaves	Cardiac tonic, demulcent
Nymphaea lotus L.	Nilofar	White lotus	Herb	Flowers	Cardiac tonic, hepatic disorders

TABLE 1. continued

Species	Local name	English name	Life form	Part used	Pharmaceutical uses
Oleaceae					
Jasminum officinale L.	Chambeli	Jasmine	Shrub	Flowers, leaves	Anthelmintic, diuretic
Nyctanthes arbor-tristis L.	Kuri	Night jasmine	Shrub	Leaves, seeds	Antibilious, laxative
Oxalidaceae					
Oxalis corniculata L.	Surchi	Indian sorrel	Herb	Leaves	Anti-scorbutic, refrigerant
Papaveraceae					
Argemone mexicana L.	Stayanasa	Yellow thistle	Herb	Whole plant	Alterative, stimulant
Pedaliaceae					
Sesamum indicum L.	Til	Sesame	Herb	Seeds	Aphrodiasic, fattening, nourishing
Plantaginaceae					
Plantago ovata Forssk.	Isabaghol	Plantain	Herb	Bark, seeds	Cooling, mucilaginous, anti-inflammatory
Plumbaginaceae					
Plumbago zeylanica L.	Chitrak	Lead wort	Herb	Roots	Stimulant, antiseptic, detersive, refrigerant
Portulacaceae					
Portulaca oleracea L.	Dholica	Purslane	Herb	Seeds	Demulcent, diuretic, astringent
Ranunuculaceae					
Nigella sativa L.	Kalonji	Black cumin	Herb	Seeds	Diuretic, galactagogue, stimulant
Rhamnaceae					
Ziziphus jujuba Mill.	Beri	Jujube	Tree	Leaves, seeds	Anti-inflammatory
Rutaceae					
Aegle marmelos (L.) Corrêa	Bel	Bil	Tree	Flowers, leaves	Laxative, expectorant
Salvadoraceae					
Salvadora oleiodes Decne.	Pil	Tooth brush tree	Tree	Bark, leaves, seeds	Vesicant, stimulant
Salvadora persica L.	Pilu	Mustard tree	Tree	Fruits, leaves	Diuretic, anthelmintic

Table 1. continued

Species	Local name	English name	Life form	Part used	Pharmaceutical uses
Sapindaceae					
Cardiospermum halicacabum L.	Kanphuti	Baloon vine	Herb	Whole plant	Demulcent, laxative
Scrophulariaceae					
Bacopa monnieri (L.) Pennell.	Brahmi	Thyme Gratiola	Herb	Whole plant	Febrifuge, nervine
Simaroubaceae					
Ailanthus excelsa Roxb.	Maharuk	Talbot	Herb	Bark, leaves	Astringent, febrifuge
Solanaceae					
Capsicum annuum L.	Mirch	Red pepper	Herb	Leaves, seeds	Pungent, sialgogue
Datura metel L.	Datura	Apple of Peru	Herb	Leaves, seeds	Narcotic, toxic, antispasmodic
Lycopersicon esculentum Mill.	Tamatar	Tomato	Herb	Fruits	Antioxidant, carminative
Solanum nigrum L.	Mako	Black nightshade	Herb	Roots, seeds	Cardiac tonic, diaphoretic
Solanum virginianum L.	Kandiari	Indian Solanum	Herb	Whole plant	Expectorant, diuretic
Withania somnifera (L.) Dunal.	Asgandh	Winter cherry	Shrub	Whole plant	Anthelmintic, stimulant
Tiliaceae					
Corchorus olitorius L.	Kost	Jute plant	Herb	Seeds, leaves	Carminative, astringent
Grewia asiatica L.	Phalsa	Grewia	Herb	Fruits	Carminative
Zingiberaceae					
Curcuma longa L.	Haldi	Turmeric	Herb	Seeds	Antimutagenic, antioxidant
Zygophyllaceae					
Fagonia cretica L.	Dama	Prickly cover	Shrub	Leaves	Refrigerant, febrifuge
Peganum harmala L.	Harmal	Harmal	Herb	Roots, seeds	Narcotic, hypnotic, emetic
Tribulus terrestris L.	Pakhra	Puncture vine	Herb	Seeds	Aphrodisiac, diuretic

demands in the traditional health care system. A total of 131 medicinal plant species in 112 genera belonging to 52 plant families are reported from the canal-irrigated areas of Punjab (Table 1). It is interesting to note that most of the medicinal plants were Dicots (48 families), while Monocots constitute only a minor fraction of them (3 families). The most important family was Fabaceae containing 21 medicinal species. This was followed by Apiaceae, Asteraceae, Lamiaceae, Solanaceae (6 species each), Cucurbitaceae, Malvaceae, and Poaceae (5 species each). Life form analysis of these medicinal plants indicated that all life forms were represented, but the majority belonged to herbaceous forms (Table 1). Herbs (80 species) were found to be the most common life form followed by trees (32 species) and shrubs (19 species). Most frequently utilized plants parts included leaves (54 species), seeds (44 species) and roots (27 species). Whole plants of 18 species were utilized in herbal medicine. The bark, fruits and flowers (16 species each) and stem and branches (10 species) also served as medicines. Onion and garlic bulbs and gums and latexes from some of the plants were also used as medicines.

The biological and physical changes associated with fragmentation and loss of habitats and canal irrigation have many residual and secondary effects that aggravate the problem of phyto-diversity loss. These include pollution, decline of soil fertility, water logging, the salinization or acidification of soil and water, the siltation of water channels and increased desertification. Among these, salinity and water logging of soils in Punjab are the most important problems (Davidson 2000). Saline soils, high temperatures and increased rate of evaporation, and limited water supply pose a serious limit back on the growth and distribution of native plants (Hussain et al. 2003). Desertification is another threat to native plants of Punjab because it particularly affects the biota of areas with 200-800 mm of average rainfall (Khan 2000). The activities that lead to or enhance desertification include cultivation of unsuitable terrains and soils, over-grazing and lack of proper livestock management practices, and excessive removal of shrubs and trees for fuel wood (Ahmad & Waseem 2004). This has resulted in the loss of many herbaceous species, including medicinal plants, in many areas of Punjab (Khan 2000).

The irrigated areas of Punjab are as rich in phyto-diversity and deserve all possible protection and conservation measures to prevent loss of wild plants. The conservation and sustainable management of medicinal plants requires a strategic action at different levels. As part of the conservation of medicinal plants, the management and use of agricultural lands need major revamping. Farmers should realize that their methods of land use and farming practices affect the surrounding environment and the organisms in that environment. As a first step towards better land management, clearing and fragmentation of native vegetation should be stopped and the extent of native plant reserves should be increased.

Medicinal plants are one of the few natural products of developing countries that could be marketed at higher prices (Athar & Ahmad 2004; Shaheen et al. 2003). The ever growing market and demand for herbal ingredients creates possibilities for cultivation of medicinal plants as crops (Hussain et al. 2003). Such efforts could provide a substantial supply of herbal plants and help increase the income of the farmers. With continuous increase in use and demand for herbal products, the gap between demand and supply is widening (Crockett & Khan 2003). It is estimated that world trade in medicinal plants and related products may reach to US$ 5 trillion by 2050 (Purohit & Vyas 2005). Most of the demand so far has been met from wild sources, which cannot last much longer. Since medicinal plants are a source of additional earnings and traditional treatments for a major part of rural population, it is recommended that these plants may be propagated and domesticated as cash crops. Thus, cultivation of medicinal plants could be a potential source of economic development that would also meet conservation objectives.

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